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Attorney Docket No.: 4825-10

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BOX PATENT APPLICATION
Washington, DC 20231

Dated: October 29, 1998

Attorney Docket #: 4825-10

Sir:

Transmitted herewith for filing is the utility patent application of:

Inventor(s): Tae Joong KIM, Seung Chan BANG, Ki Chul HAN

For: Apparatus For Making A Random Access To The Reverse Common Channel Of
A Base Station In CDMA And Method Therefor

Enclosed are:

1. Specification (27 p.), Claims 1 to 24 (11 p.) & Abstract (1 p.)
2. Executed Declaration and Power of Attorney (3 p.)
3. 5 sheet(s) of drawing(s) (Figs. 1 to 4b)
4. Assignment of the invention to **Electronics and Telecommunications Research Institute**
5. Recordation Cover Sheet (PTO-1595)
6. Check for **\$40.00** for Assignment Recording Fee
7. Verified Statement to Establish Small Entity Status
8. Certified copy of priority document No. 1998-16019
9. Letter Transmitting Priority document
10. Information Disclosure Statement
11. PTO Form 1449 with copies (5 docs.) of cited references

- [x] A fee computation sheet for this application is attached hereto.
- ☐ Please charge my Deposit Account No. 03-2412 in the amount of \$_. A duplicate copy of this sheet is enclosed.
- [x] A check in the amount of \$ 439 to cover the filing fee is enclosed.
- [x] The Commissioner is hereby authorized to charge payment of the following fees associated with this application or credit any overpayment to Deposit Acct. No. 03-2412.
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 - [x] Any filing fees under 37 CFR 1.16 for presentation of extra claims.
- [X] Priority is claimed for this invention and application, corresponding applications having been filed in **Korea** on **May 04, 1998**, No. **1998-16019**.

Respectfully submitted,
COHEN, PONTANI, LIEBERMAN & PAVANE

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In re Application of: Tae Joong KIM et al.

**For: Apparatus For Making A Random Access To The Reverse Common Channel
 Of A Base Station In CDMA And Method Therefor**

The filing fee has been calculated as shown below:

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BASIC FEE			\$395	\$790
TOTAL CLAIMS	<u>24</u> - 20 =	<u>4</u>	x 11 = \$ 44	x 22 = \$
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<input type="checkbox"/> MULTIPLE DEPENDENCY			+\$135 = \$	+ 270 \$
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09181990-10999

Attorney Docket # 4825-10

Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Tae Joong KIM et al.

Serial No.: n/a

Filed: concurrently

For: Apparatus For Making A Random
Access To The Reverse Common
Channel Of A Base Station In CDMA
And Method Therefor

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- [X] Any filing fees under 37 CFR 1.16 for presentation of extra claims.

Respectfully submitted,
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Dated: October 29, 1998

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(f) and 1.27(b)) - SMALL BUSINESS CONCERN**

Applicant or Patentee: _____
Attorney's Docket No.: _____
Serial or Patent No.: _____
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I hereby declare that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

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ADDRESS OF CONCERN: _____

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

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FULL NAME: ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE
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NAME OF PERSON SIGNING Choon Sik, Hwang
TITLE OF PERSON OTHER THAN OWNER Group Manager of Intellectual Property
Management Team
ADDRESS OF PERSON SIGNING 161, Gajeong-Dong, Yuseong-Ku, Daejeon, Korea
SIGNATURE Choon Sik, Hwang DATE October 14, 1998

APPARATUS FOR MAKING A RANDOM ACCESS TO THE REVERSE
COMMON CHANNEL SYSTEM IN CDMA AND METHOD THEREFOR

5

BACKGROUND OF THE INVENTION

Field of The Invention

The present invention concerns an apparatus for making a plurality of cellular phones randomly access a common channel to transmit data in CDMA (Code Division Multiple Access), and a method therefor.

Technical Background

Recently, it has been demanded that the mobile communication system may provide data communication services to enable exchanges of moving image and character data together with those of conventional voiced information during movement. IMT-2000 (International Mobile Telecommunication-2000) is an international project to develop a mobile communication system to enable such data communication services based on an internationally integrated standard. In addition, an effort has been made to achieve high speed data transmission with some limitation in the mobile characteristics, and particularly, the wireless LAN proposed in IEEE 802.11 standard is commercially able to make data transmission at 2 Mbps (Mega bit per sec).

Generally, the circuit-switch, which is employed in the present public switched telephone network (PSTN), digital cellular system and personal communication system, is not desirable to make such high speed data transmission because of ineffectively using a limited number of channels. In order to resolve the disadvantages of the circuit-switch, the packet-switch has been proposed to make high speed data transmission in IMT-2000, which is under development for LAN or the standard of the future mobile communication system. The band spread method of CDMA applied to the present digital cellular system has a large communication capacity, and is prevented from external tapping and stabilized to make communications under the multipath environment generated by the radio channels rapidly changed through movement, so that it is widely used in the commercial wireless LAN, CDMA One of LMNQ (Lucent Motorola, Nortel, Qualcomm, Samsung) proposed as the standard of the future IMT-2000, or W-CDMA (Wideband-CDMA) chiefly developed in Europe and Japan.

The future IMT-2000 system is to support both voiced data and packet data communications. In this case, it is very ineffective that the packet data is assigned with an exclusive channel as the voiced data. Namely, although the continuous voiced data must be assigned with an exclusive channel, it is desirable for effective use of resources and simplification of the system that the discontinuous small packet data are transmitted through the reverse common channels less than the

number of the active terminals. Moreover, if the number of the subscribers is increased, and thus the amount of the data transmitted, the reverse common channels must be necessarily used for the effective use of resources.

5 The ALOHA method is the most effective way of channel access and data transmission through the reverse common channel, and a typical random access, which is developed by Hawaii University in 1970 as a protocol for the wireless network between the islands of Hawaii State. However, such ALOHA suffers the
10 inefficiency of data transmission performed without any timed schedule between the base station and terminals, and network overloaded due to frequent collision of data transmitted by a number of terminals. The slotted ALOHA has been developed to define a standard time between the base station and terminal in
15 order to cope with such problems. This method is to allow the data transmission of a terminal only in a set time, so that the rate of substantial data and thus the transmission efficiency is increased, and the interferences from another terminal is reduced, thereby improving the efficiency of the whole network.
20 However, since the slotted ALOHA makes the data transmission basically in the contention mode, it is impossible to avoid collisions of data transmitted from the terminals. Hence, if there is an additional channel for controlling and transmitting information in the forward link from the base station to the
25 terminals, the base station broadcasts the information of the received data to the terminals in order to avoid such data

collision.

In the ALOHA system employing CDMA, each terminal uses a different code or the same code with a time offset to avoid data collision. In addition, a preamble signal is firstly transmitted to determine the power to be used for data transmission, and the initial synchronization with the code to use and the tracking of the code synchronization is performed previous to the data transmission, thereby preventing data transmission error. Describing the conventional ALOHA protocol employing CDMA in reference to Fig. 1, a terminal makes an access attempt to transmit data. The access attempt consists of a plurality of access sub-attempts, each of which in turn consists of a plurality of access probe sequences, each of which in turn consists of a plurality of access probes. The access probe consists of a preamble transmitting a pilot channel without any substantial information to evaluate the channel situation and to make the initial synchronization between the codes of the terminal and base station and the tracking of the code synchronization, and an access channel message capsule containing the access information or the user's data following the preamble. In order to transmit an access signal or data through the reverse common channel, a terminal firstly transmits an access probe at a given power level, which must have a minimum value to reduce the interferences affecting the other terminals that transmit data through an exclusive channel or other reverse common channels. Then, the terminal which made an attempt to transmit

data with the first access probe waits for a prescribed time interval TA the signal from the base station representing whether the transmitted data is received. If the first access probe fails to reach the base station, the terminal makes another attempt to retransmit the second probe at a power level increased by a given level PI compared to the power level of the first probe after a random time interval RT. If not succeeding in the data transmission through a prescribed number of the access probes of the first access probe sequence, the terminal performs the second access probe sequence after passing an additional random time interval RS.

While the conventional ALOHA protocol system employing CDMA can make a stable data transmission in the reverse common channel by performing stably the code synchronization and the tracking thereof with the preamble of a sufficient length even when many data are transmitted through the reverse common channel, the preamble is the signal to establish the code synchronization, and less important and longer than the substantial data. Thus, if the synchronization is exactly acquired in the preamble but with an error in transmission of the substantial data, the preamble should be retransmitted reducing the data transmission efficiency.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an

apparatus for making a plurality of cellular phones randomly access a common channel to transmit data in CDMA, which enables the base station to broadcast a signal representing whether it has acquired the synchronization signal of the data received through the reverse common channel or no, so as to prevent the terminals from unnecessarily transmitting data, thereby avoiding interference signals generated in the reverse common channel.

It is another object of the present invention to reduce the power used in the terminal to employ an exclusive channel or the reverse common channel to transmit data, and to enable the failed terminal to quickly retransmit data.

It is still another object of the present invention to provide an apparatus for making a plurality of cellular phones randomly access a common channel to transmit data in CDMA, which may stably perform the code synchronization and the tracking thereof with a preamble of the same length, and achieve reliable data transmission, and reduce the time taken for transmitting data.

It is further another object of the present invention to enable the base station to broadcast the information concerning the state of the channel card to all terminals in real time so as to prevent the terminals from unnecessarily transmitting data.

According to the present invention, an apparatus for making a plurality of terminals have a random access to the reverse common channel of a base station in CDMA, comprises code synchronization detection information broadcast means provided

in the base station for broadcasting the state information of a channel card in real time for the terminals to recognize the code synchronization detection when the code synchronization of a certain data is acquired through performing the code synchronization of the preambles transmitted from the terminals through the reverse common channel, and data transmission determination means provided in the terminals for making the terminals to have attempted data transmission in the same time slot with the data of the code synchronization detection continuously transmit data and the other terminals stop data transmission.

According to an aspect of the present invention, each of the terminals comprises a data generator for generating the data transmitted to the base station, a data transmitter for transmitting the data generated from the data generator, a terminal RF signal processor for converting the data from the data transmitter into an RF signal transmitted to the base station and for processing an RF signal received from the base station, a broadcast signal receiver for receiving a broadcast signal from the terminal RF signal processor to determine the data transmission, and data transmission determination circuit for controlling the data transmitter to determine whether to make an attempt of transmitting data or to keep on transmitting the data presently under transmission according to the broadcast signal.

When the data transmission determination circuit receives

a broadcast signal representing the detection of the code synchronization in a time slot from the base station, it holds the data transmission until receiving a broadcast signal representing the code synchronization not acquired when it does not perform data transmission or keeps on transmitting data when it has attempted the data transmission in the time slot corresponding to the broadcast signal or stops the data transmission performed in the time slot not corresponding to the broadcast signal and holds it until receiving a broadcast signal representing the code synchronization not acquired.

Preferably, the data transmission determination circuit determines the data transmission by receiving the broadcast signal representing the detection of the code synchronization in a time slot from the base station, the data transmission being determined by the first or second broadcast signal according as the ratio of the packet length to the slot length is 2 or 4.

The data transmitter is preferably designed to have a transmitted data unit consisting of the preamble and user's data, and the power of the preamble is set different from that of the user's data. The data transmitter performs the power control according to the power control bit transmitted after receiving the broadcast signal representing the detection of the received signal synchronization from the base station, and maintains a constant power level regardless of the power control bit transmitted upon receiving the broadcast signal representing the received signal synchronization not acquired from the base

station.

The base station preferably comprises a base station RF signal processor for receiving the RF signal transmitted from the terminal, a data transceiver for demodulating the signal from the base station RF signal processor to deliver it to an upper hierarchy or another network or vice versa, the data transceiver generating a signal representing whether the received signal synchronization is acquired or no, a detection determination circuit for receiving the resultant signal of the code synchronization used to determine whether the received signal is acquired or no upon completing the preamble of the data transmitted from the data transceiver, a broadcast determination circuit for determining the information to broadcast to the terminals according to the detection of the received signal synchronization recognized by the detection determination circuit, and a broadcast transmitter for controlling the base station RF signal processor to transmit the broadcast signal determined by the broadcast determination circuit at a prescribed power level in a prescribed time.

Preferably, the detection determination circuit determines the initial code synchronization and the tracking of the synchronization in a given time before completion of a preamble transmission to make the terminals perform the precise operation in the beginning of the slot. In addition, the detection determination circuit searches the codes around the beginning of each time slot for a duration that may vary from the length of

the time slot to the length of the preamble.

The broadcast determination circuit determines the broadcast signal only with a single bit representing the detection of the synchronization in the preamble. The broadcast transmitter
5 transmits the broadcast signal determined by the broadcast determination circuit through an additional channel using a different code other than the presently used code at every time of completing the slot. Besides, the broadcast transmitter transmits the broadcast signal determined by the broadcast
10 determination circuit at every time of completing the slot in the punctured form having the power control bit transmitted through the pilot channel and a time offset.

The present invention will now described more specifically with reference to the drawings attached only by way of examples.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

Fig. 1 is a schematic diagram for illustrating the data transmission in ALOHA system employing a common channel in
20 conventional CDMA;

Fig. 2 illustrates a CDMA network where the inventive apparatus is applied;

Fig. 3 is a block diagram for illustrating the base station communicating with the terminal according to the inventive
25 apparatus;

Fig. 4A is a timing diagram for illustrating the random

access to the reverse common channel in the inventive apparatus;
and

Fig. 4B is a timing diagram for illustrating the random
access to the reverse common channel using mini time slots in the
5 inventive apparatus.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Fig. 2, the subscriber's terminal 110 transmits
a preamble through the reverse common channel to the base
station, which performs the code synchronization to receive the
data generated from the terminal. CDMA network 300 controls a
plurality of base stations 200, 210, communicating with other
networks. PSTN (Public Switched Telephone Network) 400 also
10 communicates with the CDMA network 300 to connect the mobile
terminal 110 with the telephone subscriber. Internet 500 also
communicates with the CDMA network 300 to connect the terminal
110 with the Internet subscriber. PSDN (Public Switched Data
Network) 600 communicates with the CDMA network 300 to connect
15 the terminal 110 with the PSDN subscriber.

The base station 200 is provided with code synchronization
detection information broadcast means for broadcasting the state
information of a channel card in real time for the terminals to
recognize the code synchronization detection when the code
25 synchronization of a certain data is acquired through performing
the code synchronization of the preambles transmitted from the

terminals through the reverse common channel. In addition, each terminal 100 is provided with data transmission determination means for making the terminals to have attempted data transmission in the same time slot with the data of the code synchronization detection continuously transmit data and the other terminals stop data transmission.

As shown in Fig. 3, the terminal 110 comprise a data generator 111 for generating the data transmitted to the base station 210, a data transmitter 112 for transmitting the data generated from the data generator, a terminal RF signal processor 113 for converting the data from the data transmitter 112 into an RF signal transmitted to the base station 210 and for processing an RF signal received from the base station 210, a broadcast signal receiver 114 for receiving a broadcast signal from the terminal RF signal processor 113 to determine the data transmission, and data transmission determination circuit 115 for controlling the data transmitter 112 to determine whether to make an attempt of transmitting data or to keep on transmitting the data presently under transmission according to the broadcast signal.

The base station 210 preferably comprises a base station RF signal processor 211 for receiving the RF signal transmitted from the terminal 110, a data transceiver 212 for demodulating the signal from the base station RF signal processor 211 to deliver it to an upper hierarchy or another network or vice versa, the data transceiver 212 generating a signal representing whether the

received signal synchronization is acquired or no, a detection
determination circuit 213 for receiving the resultant signal of
the code synchronization used to determine whether the received
signal is acquired or no upon completing the preamble of the data
5 transmitted from the data transceiver 212, a broadcast
determination circuit 214 for determining the information to
broadcast to the terminals according to the detection of the
received signal synchronization recognized by the detection
determination circuit 213, and a broadcast transmitter 215 for
10 controlling the base station RF signal processor 211 to transmit
the broadcast signal determined by the broadcast determination
circuit 214 at a prescribed power level in a prescribed time.

Describing the operation of the inventive apparatus in
connection with Figs. 3 and 4, the data generator 111 of the
terminal 110 generates the data consisting of a control signal
15 to connect the terminal 110 with the base station 210 and a
substantial data transmitted by the user of the terminal 110. The
data may be transmitted through an exclusive channel or the
reverse common channel according to the traffic characteristics.

20 In the inventive apparatus, the data is transmitted through the
reverse common channel. The data generated from the data
generator is determined to be transmitted or not according to the
broadcast signal received from the base station 210.

The hub RF signal processor 211 of the base station 210
25 converts the RF signal into the base band signal transmitted to
the data transceiver 212, which performs the initial code

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and the output signal of the detection determination circuit 213.

Then, the broadcast transmitter 215 transmits the information representing the detection of the code synchronization instead of PCB (Power Control Bit) at the boundary of the time slot in order to transmit in real time the broadcast signal determined by the broadcast determination circuit 214 as transmitting PCB through the pilot channel. The possible time delay, as described above, may occur before transmission of the preamble, and therefore the prepared broadcast signal is broadcast before the beginning of the time slot to prevent the performance degradation.

The terminals 110 determines the subsequent operations depending on the information of the code synchronization received from the base station 210. When the base station 210 transmits the signal representing the detection of the code synchronization of the data transmitted through the reverse common channel in a specific time slot, the terminals that have not transmitted data must hold until the completion of transmitting the acquired data while the terminals that have attempted data transmission in the corresponding time slot keep on transmitting the data. Of course, the terminals that have attempted data transmission in the other time slots must stop the transmission until the completion of transmitting the acquired data.

Fig. 4A illustrates the example of attempting the data transmission using the beginning of the time slot determined by the system time set in the system. In this case, it is assumed

that the length of the preamble necessary for the code synchronization for the data transmission is twice the data length. The time taken for a single data transmission consists of a plurality of time slots. The terminal 110 including the data
5 newly generated or to be retransmitted before the beginning of the first time slot S_0 performs the data transmission in the first time slot interval S_0-S_1 . As shown in Fig. 4A, the five data are simultaneously transmitted, and in the next time slot interval S_1-S_2 are transmitted two data through the reverse common channel to the base station. Hence, the total of the data
10 transmitted in the second time slot interval is seven.

Firstly, it is assumed that the base station performs the initial code synchronization and the tracking thereof by detecting one of the five data transmitted in the first time slot interval S_0-S_1 . This assumption may be taken valid because the data are acquired different in power level or transmission delay even if transmitted simultaneously according to the distance between the base station 200 and the terminal 110. Therefore, as shown in Fig. 4A, the detection of the data transmitted at the
15 beginning of the first time slot S_0 is recognized by the base station 200 at the beginning of the third time slot S_2 , transmitted to all the terminals. Then, the terminal 110 determines the next operation according to the broadcast signal received through the terminal RF signal processor 113 and the
20 broadcast signal receiver 114. Namely, receiving the broadcast signal, the terminals that have made the data transmission at the
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beginning of the first time slot S_0 keep on transmitting data, performing closed loop power control by using the PCB transmitted from this time. Since the previous PCB is invalid due to the preamble not acquired, the closed loop power control of the preamble prior to broadcasting the synchronization detection signal may cause abrupt change to the power generated from the terminal 110.

In the mean time, the terminals that have made data transmission at time points other than the beginning of the first time slot stop the transmission to attempt retransmission in the time slot at which the next not acquired signal is transmitted. On the other hand, if the broadcast signal represents the synchronization not acquired, the terminal does not perform an additional operation, keeping on carrying out the operation done in the previous time slot interval. In this way, the base station may achieve more precise demodulation of the acquired data because of reduced signal interference, transmitting data in the increased power without degradation of the overall system performance. Namely, the data acquired from the preamble may be stably demodulated, so that the time taken for the transmission is reduced and the transmission efficiency is improved.

Fig. 4B illustrates the data transmission procedure where the length of the time slot is more reduced. The length of the preamble for the code synchronization is twice the data length as in Fig. 4A. In this case, each time slot is divided into a plurality of smaller time slots, so that the number of the

terminals 110 is reduced for a time slot. A data is transmitted in the beginning of the first time slot S_{0-0} , and two data in the beginning of the next time slot S_{0-1} , so that the amount of the data transmitted at the beginning of each time slot is reduced, thus increasing the probability of detecting in the preamble compared to the case of Fig. 4A.

Consequently, the data transmitted in the second time slot S_{0-1} is acquired by the base station 200 to broadcast the detection signal to the terminal 110 in the time slot S_{2-1} of completing the preamble. Receiving the detection signal, the terminals that have performed data transmission in the beginning of the second time slot S_{0-1} keep on transmitting data while the terminals that have performed data transmission in the other time slots stop transmission, holding until the time slot S_{3-1} of receiving the signal not acquired from the base station, and thus the terminals that have not performed data transmission. Compared to Fig. 4A where two of seven terminals stop transmission, the five terminals stop data transmission, and therefore it will be noted that the reduced slot secures the stable data transmission with reduced signal interference. Thus, the reduced slot length reduces the probability of transmitting data in the same time slot, so that there is increased the number of the terminals stopping unnecessary transmission after detection of the preamble. This increases the stability of data transmission, decreasing the signal interference in the terminals using the exclusive channel or other reverse common channels. However,

since the signal broadcast from the base station 200 to the terminal 110 is determined by the signal received from the terminal, it is required that the slot length is maintained over a prescribed level to minimize the disadvantages caused by the transmission delay or multi-path. Namely, if the slot length is reduced below the prescribed level to reduce the level of the interference signal, the performance of the overall system is degraded because of increasing the frequency of the signal interference. Hence, it is desirable to select the slot length that may reduce the level of the signal interference with minimizing the disadvantages caused by the transmission delay and multi-path.

In another aspect of the present invention, a method for making a plurality of terminals have a random access to the reverse common channel of a base station in CDMA, comprises the steps of broadcasting from the base station the state information of a channel card in real time for the terminals to recognize the code synchronization detection when the code synchronization of a certain data is acquired through performing the code synchronization of the preambles transmitted from the terminals through the reverse common channel, and making the terminals to have attempted data transmission in the same time slot with the data of the code synchronization detection continuously transmit data and the other terminals stop data transmission.

Preferably, the step of making the terminals transmit data comprises the steps of generating the data transmitted to the

base station, transmitting the data to the base station, converting the data into an RF signal transmitted to the base station and processing a broadcast RF signal received from the base station, receiving the converted broadcast RF signal to
5 determine the data transmission, and determining whether to make an attempt of transmitting data or to keep on transmitting the data presently under transmission according to the broadcast signal.

Preferably, the step of broadcasting in the base station
10 comprises the steps of receiving the RF signal transmitted from the terminal, demodulating the signal from the base station RF signal processor to deliver it to an upper hierarchy or another network or vice versa, and generating a signal representing whether the received signal synchronization is acquired or no,
15 receiving the resultant signal of the code synchronization used to determine whether the received signal is acquired or no upon completing the preamble of the data transmitted, determining the information to broadcast to the terminals according to the detection of the received signal synchronization, and controlling
20 the base station to transmit the broadcast signal at a prescribed power level in a prescribed time.

Describing the operation of the inventive method in connection with Fig. 4, the data generator of the terminal generates the data consisting of a control signal to connect the
25 terminal with the base station and a substantial data transmitted by the user of the terminal. The data generated from the data

generator is determined to be transmitted or not according to the broadcast signal received from the base station.

5 The hub RF signal processor of the base station converts the RF signal into the base band signal transmitted to the data transceiver, which performs the initial code synchronization and the tracking thereof through the preamble of the data received the reverse common channel. Generally speaking, while the initial code synchronization and the tracking thereof may be determined after completing of the preamble receiving, the probability to achieve the code synchronization may be approximately evaluated by means of the power of the received signal even before completion of the preamble receiving, so that the broadcast signal may be determined prior to completion of the preamble transmission, and therefore the time taken for determining and transmitting the broadcast signal may be reduced, thus making it possible to broadcast in real time. Hence, the effect of broadcasting thus determined broadcast signal to all terminals prevents the interference signals because the other terminals are stopped to transmit data when the code synchronization has been attained.

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Consequently, the base station 210 decodes the data received through the reverse common channel to make an error detection, and broadcasts the signal representing the detection of the code synchronization of the received data to the terminals in real time. Namely, the detection determination circuit transfers the resultant signal of the code synchronization detection of the

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received signal from the data transceiver after completion of the preamble to the broadcast determination circuit, which determines the preparation to demodulate the data according to the signal from the data transceiver representing demodulation such as the signal of the synchronization detection and the output signal of the detection determination circuit. Then, the broadcast transmitter transmits the information representing the detection of the code synchronization instead of PCB at the boundary of the time slot in order to transmit in real time the broadcast signal determined by the broadcast determination circuit as transmitting PCB through the pilot channel.

The terminals determine the subsequent operations depending on the information of the code synchronization received from the base station. When the base station transmits the signal representing the detection of the code synchronization of the data transmitted through the reverse common channel in a specific time slot, the terminals that have not transmitted data must hold until the completion of transmitting the acquired data while the terminals that have attempted data transmission in the corresponding time slot keep on transmitting the data. Of course, the terminals that have attempted data transmission in the other time slots must stop the transmission until the completion of transmitting the acquired data.

Fig. 4A illustrates the example of attempting the data transmission using the beginning of the time slot determined by the system time set in the system. Since the preamble and data

constitute a transmission data unit, the performance depends on the power and length of the preamble. Hence, if the transmission data unit is greater than twice the time slot, the inventive effect is achieved, or otherwise, the effect not obtained. The present invention sets the time slot smaller than the conventional time slot to improve the performance. The time taken for a single data transmission consists of a plurality of time slots. The terminal including the data newly generated or to be retransmitted before the beginning of the first time slot S_0 performs the data transmission in the first time slot interval S_0-S_1 . As shown in Fig. 4A, the five data are simultaneously transmitted, and in the next time slot interval S_1-S_2 are transmitted two data through the reverse common channel to the base station. Hence, the total of the data transmitted in the second time slot interval is seven.

Firstly, it is assumed that the base station performs the initial code synchronization and the tracking thereof by detecting one of the five data transmitted in the first time slot interval S_0-S_1 . This assumption may be taken valid because the data are acquired different in power level or transmission delay even if transmitted simultaneously according to the distance between the base station and the terminal. Therefore, as shown in Fig. 4A, the detection of the data transmitted at the beginning of the first time slot S_0 is recognized by the base station at the beginning of the third time slot S_2 , transmitted to all the terminals. Then, the terminal determines the next

operation according to the broadcast signal received through the terminal RF signal processor and the broadcast signal receiver. Namely, receiving the broadcast signal, the terminals that have made the data transmission at the beginning of the first time slot S_0 keep on transmitting data, performing closed loop power control by using the PCB transmitted from this time. Since the previous PCB is invalid due to the preamble not acquired, the closed loop power control of the preamble prior to broadcasting the synchronization detection signal may cause abrupt change to the power generated from the terminal.

In the mean time, the terminals that have made data transmission at time points other than the beginning of the first time slot stop the transmission to attempt retransmission in the time slot at which the next signal not acquired is transmitted. On the other hand, if the broadcast signal represents the synchronization not acquired, the terminal does not perform an additional operation, keeping on carrying out the operation done in the previous time slot interval. In this way, the base station may achieve more precise demodulation of the acquired data because of reduced signal interference, transmitting data in the increased power without degradation of the overall system performance. Namely, the data acquired from the preamble may be stably demodulated, so that the time taken for the transmission is reduced and the transmission efficiency is improved.

Fig. 4B illustrates the data transmission procedure where the length of the time slot is more reduced. The length of the

preamble for the code synchronization is twice the data length as in Fig. 4A. In this case, each time slot is divided into a plurality of smaller time slots, so that the number of the terminals is reduced for a time slot. A data is transmitted in the beginning of the first time slot S_{0-0} , and two data in the beginning of the next time slot S_{0-1} , so that the amount of the data transmitted at the beginning of each time slot is reduced, thus increasing the probability of detecting in the preamble compared to the case of Fig. 4A.

Consequently, the data transmitted in the second time slot S_{0-1} is acquired by the base station to broadcast the detection signal to the terminal in the time slot S_{2-1} of completing the preamble. Receiving the detection signal, the terminals that have performed data transmission in the beginning of the second time slot S_{0-1} keep on transmitting data while the terminals that have performed data transmission in the other time slots stop transmission, holding until the time slot S_{3-1} of receiving the signal not acquired from the base station, and thus the terminals that have not performed data transmission. Compared to Fig. 4A where two of seven terminals stop transmission, the five terminals stop data transmission, and therefore it will be noted that the reduced slot secures the stable data transmission with reduced signal interference. Thus, the reduced slot length reduces the probability of transmitting data in the same time slot, so that there is increased the number of the terminals stopping unnecessary transmission after detection of the

preamble. This increases the stability of data transmission, decreasing the signal interference in the terminals using the exclusive channel or other reverse common channels. However, since the signal broadcast from the base station to the terminal is determined by the signal received from the terminal, it is required that the slot length is maintained over a prescribed level to minimize the disadvantages caused by the transmission delay or multi-path. Namely, if the slot length is reduced below the prescribed level to reduce the level of the interference signal, the performance of the overall system is degraded because of increasing the frequency of the signal interference. Hence, it is desirable to select the slot length that may reduce the level of the signal interference with minimizing the disadvantages caused by the transmission delay and multi-path

Thus, the base station broadcasts a signal representing the detection of the synchronization of the data transmitted through the reverse common channel to all terminals to selectively stop unnecessary data transmission, preventing the reverse common channel from being affected by the unnecessary signal interference. This reduces the signal interference in the radio channel to decrease the power used by the terminal performing data transmission through the exclusive or reverse common channel. In addition, the terminals failed in data transmission through the reverse common channel may expediently perform retransmission, reducing delay time. Hence, the inventive apparatus may be properly applied to a high speed data

transmission system such as IMT-2000.

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WHAT IS CLAIMED IS:

1. An apparatus for making a plurality of terminals have
a random access to the reverse common channel system in CDMA,
5 comprising:

code synchronization detection information broadcast means
provided in said base station for broadcasting the state
information of a channel card in real time for said terminals to
recognize the code synchronization detection when the code
10 synchronization of a certain data is acquired through performing
the code synchronization of the preambles transmitted from said
terminals through said reverse common channel; and

data transmission determination means provided in said
terminals for making the terminals to have attempted data
15 transmission in the same time slot with the data of said code
synchronization detection continuously transmit data and the
other terminals stop data transmission.

2. An apparatus for making a plurality of terminals have
20 a random access to the reverse common channel system in CDMA, as
defined in Claim 1, wherein each of said terminals comprises:

a data generator for generating the data transmitted to said
base station;

a data transmitter for transmitting said data generated from
25 said data generator;

a terminal RF signal processor for converting said data from

said data transmitter into an RF signal transmitted to said base station and for processing an RF signal received from said base station;

5 a broadcast signal receiver for receiving a broadcast signal from said terminal RF signal processor to determine the data transmission; and

10 data transmission determination circuit for controlling said data transmitter to determine whether to make an attempt of transmitting data or to keep on transmitting the data presently under transmission according to said broadcast signal.

3. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 2, wherein, when said data transmission determination circuit receives a broadcast signal representing the detection of the code synchronization in a time slot from said base station, it holds the data transmission until receiving a broadcast signal representing the code synchronization not acquired when it does not perform data transmission or keeps on transmitting data when it has attempted the data transmission in the time slot corresponding to said broadcast signal or stops the data transmission performed in the time slot not corresponding to said broadcast signal and holds it until receiving a broadcast signal representing the code synchronization not acquired.

25 4. An apparatus for making a plurality of terminals have

a random access to the reverse common channel system in CDMA, as defined in Claim 3, wherein said data transmission determination circuit determines the data transmission by receiving the broadcast signal representing the detection of the code synchronization in a time slot from said base station, the data transmission being determined by the first or second broadcast signal according as the ratio of the packet length to the slot length is 2 or 4.

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5. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 2, wherein said data transmitter is designed to have a transmitted data unit consisting of the preamble and user's data, and the power of said preamble is set different from that of said user's data.

6. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 2, wherein said data transmitter performs the power control according to the power control bit transmitted after receiving the broadcast signal representing the detection of the received signal synchronization from said base station, and maintains a constant power level regardless of the power control bit transmitted upon receiving the broadcast signal representing the received signal synchronization not acquired from said base station.

7. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 1, wherein said base station comprises:

a base station RF signal processor for receiving the RF signal transmitted from the terminal;

a data transceiver for demodulating the signal from said base station RF signal processor to deliver it to an upper hierarchy or another network or vice versa, said data transceiver generating a signal representing whether the received signal synchronization is acquired or no;

a detection determination circuit for receiving the resultant signal of the code synchronization used to determine whether the received signal is acquired or no upon completing the preamble of the data transmitted from said data transceiver;

a broadcast determination circuit for determining the information to broadcast to said terminals according to the detection of the received signal synchronization recognized by said detection determination circuit; and

a broadcast transmitter for controlling said base station RF signal processor to transmit the broadcast signal determined by said broadcast determination circuit at a prescribed power level in a prescribed time.

8. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 7, wherein said detection determination circuit

determines the initial code synchronization and the tracking of the synchronization in a given time before completion of a preamble transmission to make said terminals perform the precise operation in the beginning of the slot.

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9. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 8, wherein said detection determination circuit searches the codes around the beginning of each time slot for a duration that may vary from the length of the time slot to the length of the preamble.

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10. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 7, wherein said broadcast determination circuit determines the broadcast signal only with a single bit representing the detection of the synchronization in the preamble.

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11. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 7, wherein said broadcast transmitter transmits the broadcast signal determined by said broadcast determination circuit through an additional channel using a different code other than the presently used code at every time of completing the slot.

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12. An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 7, wherein said broadcast transmitter transmits the broadcast signal determined by said broadcast determination circuit at every time of completing the slot in the punctured form having the power control bit transmitted through the pilot channel and a time offset.

13. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, comprising the steps of:

broadcasting from said base station the state information of a channel card in real time for said terminals to recognize the code synchronization detection when the code synchronization of a certain data is acquired through performing the code synchronization of the preambles transmitted from said terminals through said reverse common channel; and

making the terminals to have attempted data transmission in the same time slot with the data of said code synchronization detection continuously transmit data and the other terminals stop data transmission.

14. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 13, wherein the step of making the terminals transmit data comprising the steps of:

generating the data transmitted to said base station;

transmitting said data to said base station;

converting said data into an RF signal transmitted to said
base station and processing a broadcast RF signal received from
5 said base station;

receiving the converted broadcast RF signal to determine the
data transmission; and

determining whether to make an attempt of transmitting data
or to keep on transmitting the data presently under transmission
10 according to said broadcast signal.

15 15. A method for making a plurality of terminals have a
random access to the reverse common channel system in CDMA, as
defined in Claim 14, wherein the step of transmission
determination comprises the step of holding the data transmission
until receiving a broadcast signal representing the code
synchronization not acquired when it does not perform data
transmission or keeps on transmitting data when it has attempted
the data transmission in the time slot corresponding to said
20 broadcast signal or stops the data transmission performed in the
time slot not corresponding to said broadcast signal and holds
it until receiving a broadcast signal representing the code
synchronization not acquired, when receiving a broadcast signal
representing the detection of the code synchronization in a time
25 slot from said base station.

16. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 15, wherein the step of transmission determination includes the further step of determining the data transmission by receiving the broadcast signal representing the detection of the code synchronization in a time slot from said base station, the data transmission being determined by the first or second broadcast signal according as the ratio of the packet length to the slot length is 2 or 4.

17. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 14, wherein the step of data transmission has a transmitted data unit consisting of the preamble and user's data, and the power of said preamble is set different from that of said user's data.

18. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 14, wherein the step of data transmission performs the power control according to the power control bit transmitted after receiving the broadcast signal representing the detection of the received signal synchronization from said base station, and maintains a constant power level regardless of the power control bit transmitted upon receiving the broadcast signal representing the received signal synchronization not acquired

from said base station.

19. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 13, wherein the step of broadcasting in said base station comprises the steps of:

receiving the RF signal transmitted from the terminal;

demodulating the signal from said base station RF signal processor to deliver it to an upper hierarchy or another network or vice versa, and generating a signal representing whether the received signal synchronization is acquired or no;

receiving the resultant signal of the code synchronization used to determine whether the received signal is acquired or no upon completing the preamble of the data transmitted;

determining the information to broadcast to said terminals according to the detection of the received signal synchronization; and

controlling said base station to transmit the broadcast signal at a prescribed power level in a prescribed time.

20. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 19, wherein the step of receiving the resultant signal determines the initial code synchronization and the tracking of the synchronization in a given time before completion of a preamble transmission to make said terminals perform the

precise operation in the beginning of the slot.

21. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 20, wherein the step of receiving the resultant signal searches the codes around the beginning of each time slot for a duration that may vary from the length of the time slot to the length of the preamble.

22. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 19, wherein the step of determining the information to broadcast determines the broadcast signal only with a single bit representing the detection of the synchronization in the preamble.

23. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 19, wherein the step of controlling said base station transmits the broadcast signal through using a different code other than the presently used code at every time of completing the slot.

24. A method for making a plurality of terminals have a random access to the reverse common channel system in CDMA, as defined in Claim 19, wherein the step of controlling said base

station transmits the broadcast signal at every time of completing the slot in the punctured form having the power control bit transmitted through the pilot channel and a time offset.

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ABSTRACT

An apparatus for making a plurality of terminals have a random access to the reverse common channel system in CDMA, comprises code synchronization detection information broadcast means provided in the base station for broadcasting the state information of a channel card in real time for the terminals to recognize the code synchronization detection when the code synchronization of a certain data is acquired through performing the code synchronization of the preambles transmitted from the terminals through the reverse common channel, and data transmission determination means provided in the terminals for making the terminals to have attempted data transmission in the same time slot with the data of the code synchronization detection continuously transmit data and the other terminals stop data transmission.

FIG. 1

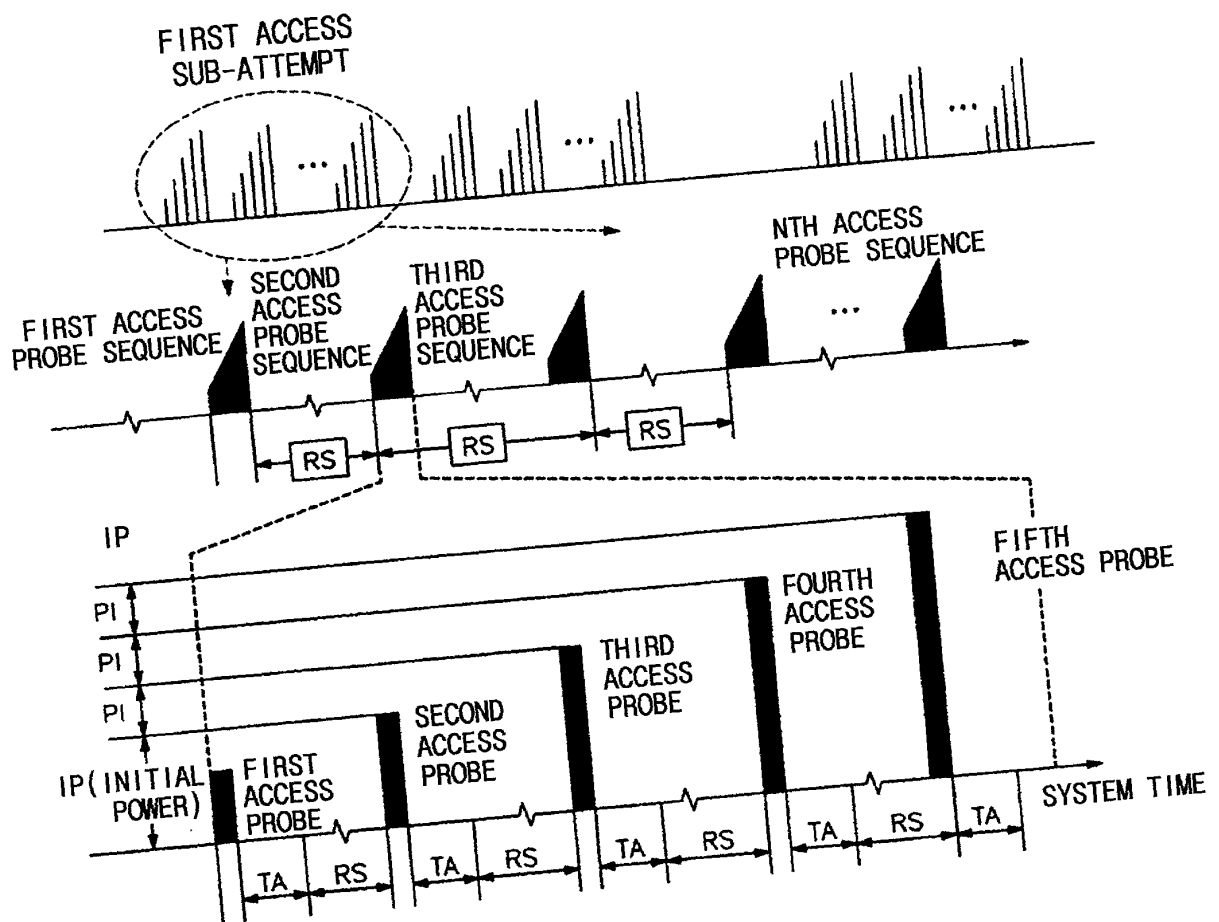


FIG. 2

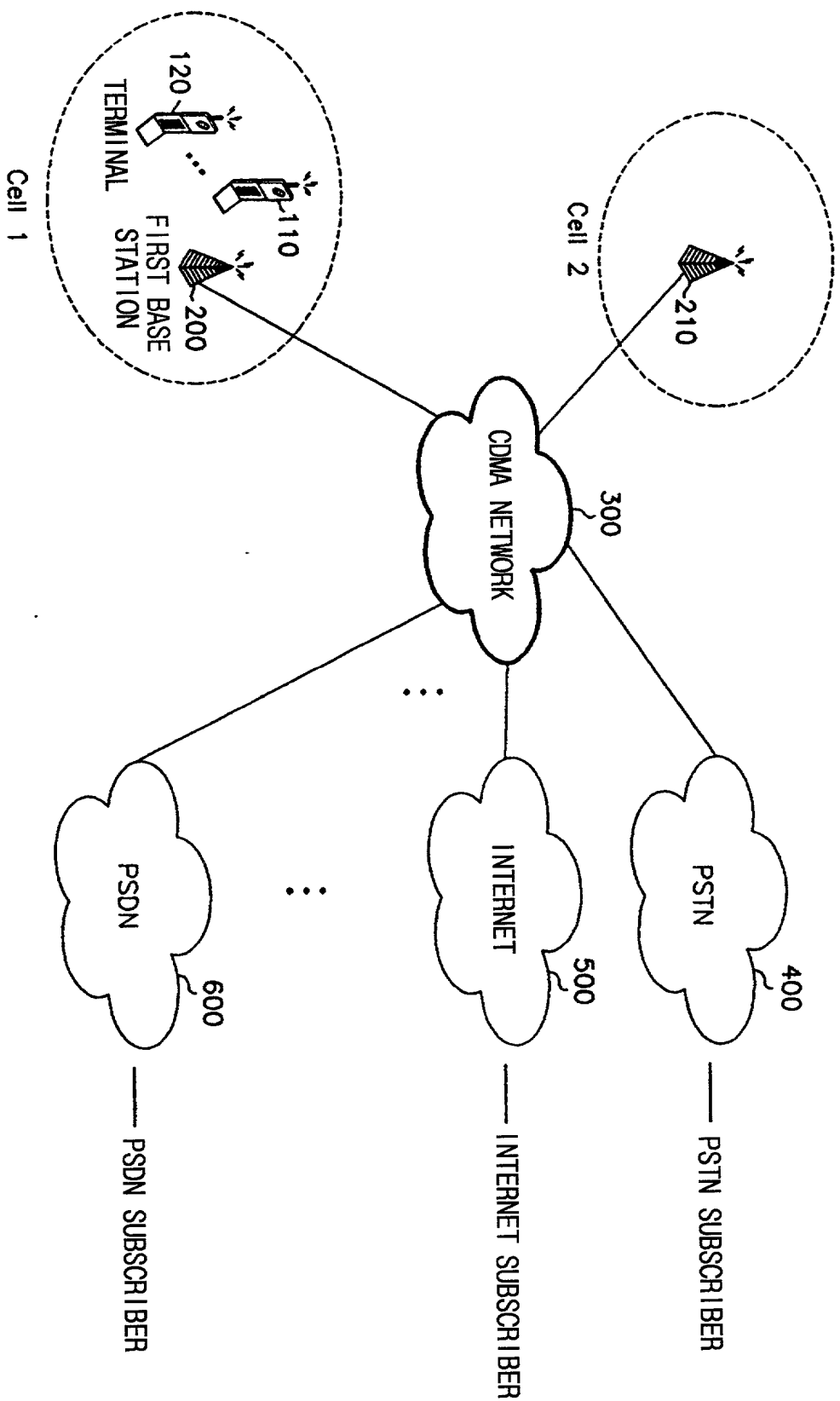


FIG. 3

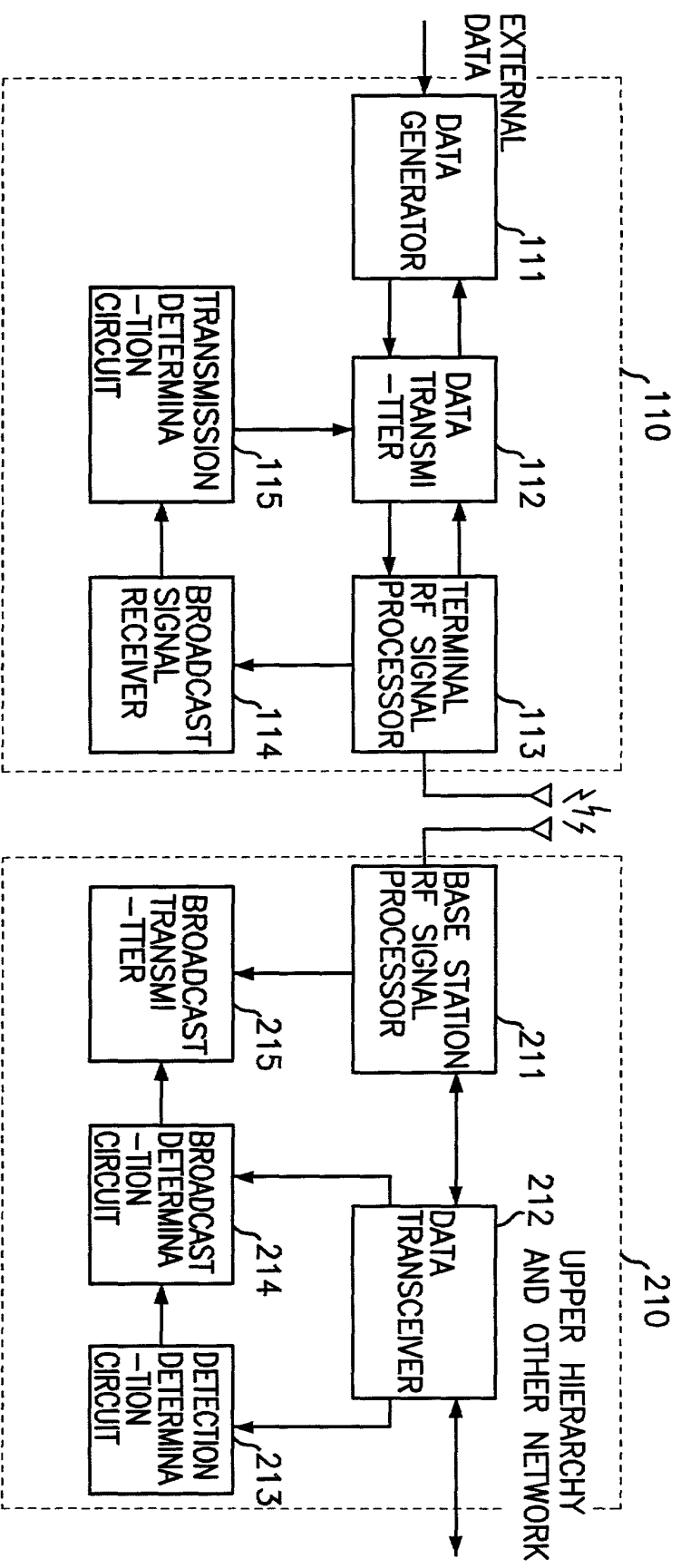


FIG. 4A

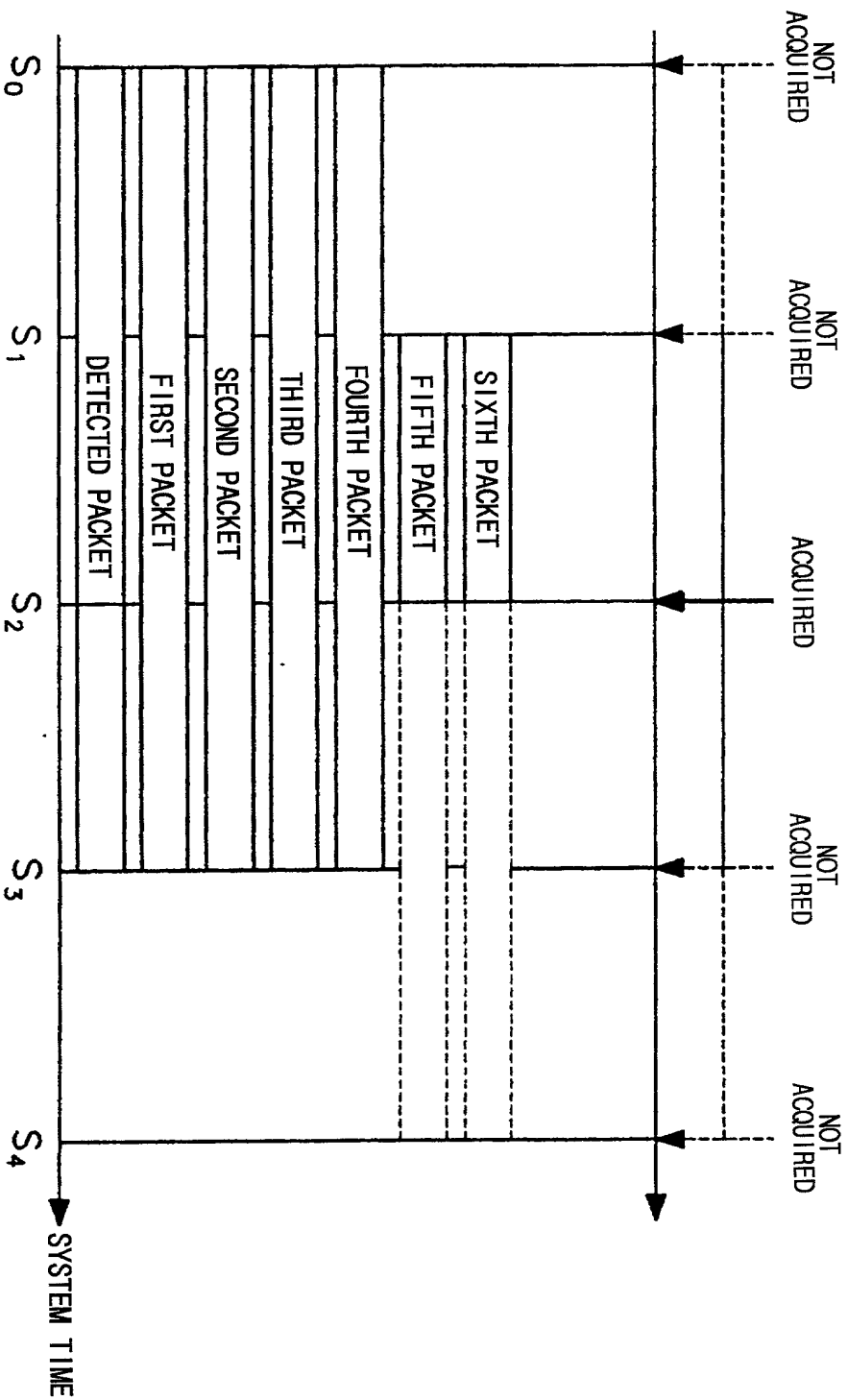
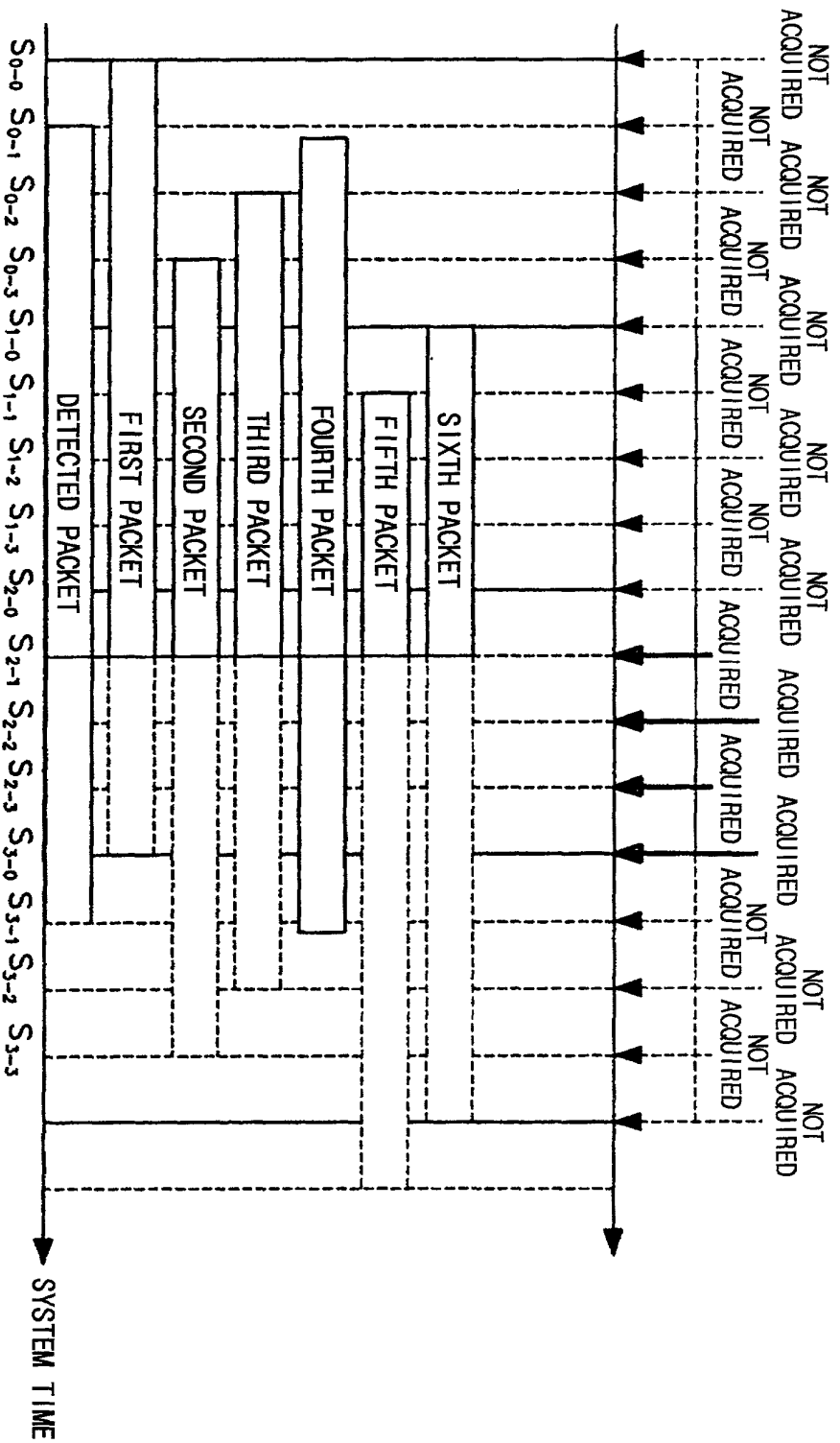


FIG. 4B



COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
Includes Reference to PCT International Applications

Attorney's Docket No.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Apparatus for making a random access to the reverse common channel system in CDMA and method therefor

the specification of which (check only one item below)

☒ is attached hereto

☐ was filed as United States application

Serial No. _____

on _____

and was amended

on _____ (if applicable).

☐ was filed as PCT international application

Number _____

on _____

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, § 56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 19 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Republic of Korea	98-16019	04/05/1998	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Continued) Includes Reference to PCT International Applications				Attorney's Docket No.	
<p>I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:</p>					
PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:					
U.S. APPLICATIONS			STATUS (check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED	
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			
<p>POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (List name and registration number)</p> <p>MYRON COHEN, Reg. No. 17,358; THOMAS C. PONTANI, Reg. No. 29,763; LANCE J. LIEBERMAN, Reg. No. 28,437; MARTIN B. PAVANE, Reg. No. 28,337; MICHAEL C. STUART, Reg. No. 35,698; JAMES J. DeCARLO, Reg. No. 36,120; CAROL E. ROZEK, Reg. No. 36,993; EDWARD M. WEISZ, Reg. No. 37,257; KLAUS P. STOFFEL, Reg. No. 31,668; CHI K. ENG, Reg. No. 38,870; EDWARD ETKIN, Reg. No. 37,824; CHERYL COHEN, Reg. No. 40,361; and JULIA S. KIM, Reg. No. 36,567.</p>					
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****ETRI : ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE**

2 0 3	FULL NAME OF INVENTOR	FAMILY NAME HAN	FIRST GIVEN NAME KI	SECOND GIVEN NAME CHUL
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2 0 4	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 5	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 6	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)				Attorney's Docket No.
<p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.</p>				
SIGNATURE OF INVENTOR 201		SIGNATURE OF INVENTOR 202		SIGNATURE OF INVENTOR 203
Kim, Tae Joong		Bang Seung Chan		Ham, Ki Chul
DATE October 14, 1998		DATE October 14, 1998		DATE October 14, 1998
SIGNATURE OF INVENTOR 204		SIGNATURE OF INVENTOR 205		SIGNATURE OF INVENTOR 206
DATE				